EDITION B

The Journal of the
INSTITUTION OF PRODUCTION ENGINEERS

Vol. XXII No. 2

FEBRUARY, 1943

CONTENTS

Published Monthly by the Institution of Production Engineers
36, Portman Square, London, W.1. Telephone : Welbeck 2233
Price 5/-

Cylinder barrel forgings in Hiduminium R.R. 59

It's Aluminium! -can it be easily machined?

Cylinder barrel after machining

OF course it can! The excellent workability of aluminium alloys is shown by the high machining speeds which can be employed. Actually, using carbide tools, speeds of 7,000 feet per minute can be achieved.

Ease of fabrication is only one of the unique qualities of HIDUMINIUM Aluminium Alloys—qualities that will enable designers in many branches of industry to revolutionise the post-war development of their products. The experience gained from long years of exacting service in the aircraft industry is available to all users. If aluminium alloys have a part to play in your plans for the future, we invite you to write to the Development Department for further details.

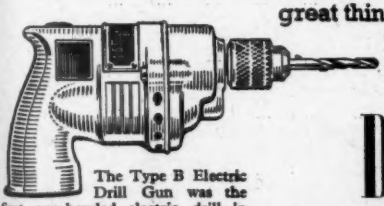
Hiduminium

HIGH DUTY ALLOYS LIMITED · SLOUGH

FEATHERS OR LEAD?

Which is the heavier—a pound of feathers or a pound of lead? The accepted answer, of course, is that it all depends on the size. But a better answer is that they both weigh a lot more after you've carried them a mile and a darned sight more after five miles.

The scientific fact (don't argue, boy; go and ask a soldier in full equipment) . . . this scientific fact, we repeat, is known to millions of workers whose duties compel them, hour after hour, to handle, lift, operate, manipulate, pick up and lay down shovels, iron bars, bricks and indeed any kind of tool or material. That is why we consider the lightness of Desoutter Tools one of their chief virtues. As light as a feather, you say when you first handle one; the great thing is that you will *still* say so some hours later when you've drilled hundreds and hundreds of holes.



The Type B Electric Drill Gun was the first one-handed electric drill in the world. Weight 2¼ lbs. Speed 1,400 r.p.m. Capacity ¼".

DESOUTTER

Specialists in Lightweight Pneumatic & Electric Portable Tools.

DRILL GUNS · SCREWDRIVERS · NUTRUNNERS · SHEARS · GRINDERS · COUNTERSINKING TOOLS · BOLT MILLING TOOLS. DESOUTTER BROS. LTD., DEPT. B, THE HYDE, HENDON, LONDON, N.W.9. PHONE: COLINDALE 6346-7-8-9. GRAMS: DESPNUCO, HYDE, LONDON. WORLD-WIDE REPRESENTATION.

C.R.C 125

INDEX TO ADVERTISEMENTS

As a war-time measure the advertisement section of this Journa. is now published in two editions, A and B. Advertisers' announcements only appear in one edition each month, advertisements in edition A alternating with those in edition B the following month. This Index gives the page number and edition in which the advertisements appear for the current month.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in "The Journal" should not be taken as an indication that they are necessarily available for export.

No. 2E All Electric
The 1" bar capacity . . . .

CAPSTAN LATHE and TOOL EQUIPMENT for HIGH PRODUCTION

Orders can be accepted and delivery allocated only on Certification of the Machine Tool Control.

TIMBRELL & WRIGHT
MACHINE TOOL & ENGINEERING CO. LTD.
SLANEY ST. BIRMINGHAM 4

Agents for London and Eastern and Southern Counties : George Hatch, Ltd., Queenhithe, Upper Thames Street, London, E.C.4

INSTITUTION NOTES

February 1943

Fixtures.

February 26—North Eastern Section. Lecture on "Nitriding and Case Hardening of Steels" by Lt. Col. J. A. McWilliam, R.E.

February 27—Yorkshire Section. Joint Meeting with Leeds and District Branch of Institute of Welding when a lecture will be given on "Organisation of Welded Production" by K. Doherty, Esq., of the Advisory Service on Welding, of the Ministry of Supply.

The late General Secretary.

A Requiem will be sung for Richard Hazleton, late General Secretary, on Saturday, February 27, 1943, at 11-30 a.m., at St. James', Spanish Place, Manchester Square, London, W.1.

Personal.

Mr. H. E. Chambers (*Member*), has been appointed Assistant Controller, Machine Tool Control.

Addresses Wanted.

Birmingham Section: F. A. Betts, A.M.I.P.E., L. F. Broadbent, A.M.I.P.E., J. W. Foley, A.M.I.P.E., A. J. P. Warwick, M.I.P.E., G. Williams, M.I.P.E.

Birmingham Graduate Section: M. Gaunt, STUD.I.P.E., B. H. Gray, GRAD.I.P.E., H. D. Jarvis, GRAD.I.P.E., Eric Mells, GRAD.I.P.E., A. G. Smith, GRAD.I.P.E., B. H. Wakeman, GRAD.I.P.E.

Coventry Section: H. R. Crowther, M.I.P.E., G. D. R. Davison, A.M.I.P.E., L. A. Taylor, A.M.I.P.E.

Glasgow Section: W. G. Gibson, M.I.P.E., J. A. Hill, M.I.P.E., A. C. Livingston, A.M.I.P.E., A. D. Macintrye, A.M.I.P.E., Capt. W. B. Roxburgh, INT.A.M.I.P.E.

Leicester Section: W. Hickman, M.I.P.E., B. K. Nehru, STUD.I.P.E.

London Section: George Bell, INT.A.M.I.P.E., A. A. Best, A.M.I.P.E., G. Buckle, A.M.I.P.E., L. J. Fry, A.M.I.P.E., A. W. Gegan,

INT.A.M.I.P.E., A. G. Ledingham, M.I.P.E., A. W. Palmer, A.M.I.P.E., F. C. Young, A.M.I.P.E.

London Graduate Section: A. K. Anderson, GRAD.I.P.E., H. Bloch, STUD.I.P.E., H. H. L. Ward, GRAD.I.P.E., R. Black, STUD.I.P.E.

Luton Section: A. J. Davey, A.M.I.P.E., W. A. Purves, A.M.I.P.E., F. Southwell, M.I.P.E.

Manchester Section: Robert Johnston, A.M.I.P.E., R. Wake, A.M.I.P.E.,

North Eastern Section: R. K. Snowball, GRAD.I.P.E.

Nottingham Section: Major G. S. Bellamy, M.I.P.E., A. Houghton, INT.A.M.I.P.E., A. J. Voce, M.I.P.E.

Overseas Section: C. G. Harrison, A.M.I.P.E.

Preston Section: A. C. Allen, A.M.I.P.E., H. J. Armstrong, M.I.P.E., J. H. Devonald, INT.A.M.I.P.E., J. T. Overall, GRAD.I.P.E.

Sheffield Section: Arthur Shaw, A.I.P.E.

South Wales Section: J. A. Crofton, INT.A.M.I.P.E.

Western Section: A. B. Bassett, GRAD.I.P.E., E. Simpson, INT.A.M.I.P.E. W. E. Wright, GRAD.I.P.E., E. W. White, A.M.I.P.E.

PROBLEMS OF SHIFT WORKING IN A GENERAL ENGINEERING FACTORY

An informal discussion held by the London Section on November 21st., 1942

THE chairman, in introducing the opener of the discussion, Mr. H. W. Hobbs, said : This meeting is in the nature of an innovation. Mr. Hobbs has not come here to impart information, but to ask for the advice and experience of others who are meeting the problems with which he is confronted, and he would welcome details of any methods which have been found useful in overcoming those problems. The discussion need not be confined, however, to satisfying Mr. Hobbs ; probably others will have difficulties to bring forward. To obtain the maximum benefit from this meeting we should exchange our difficulties and our experiences, to our mutual advantage.

Mr. H. W. Hobbs : I should like to elaborate the notes which have been distributed with the notice of this meeting, and to tell you something about the factory where my problems have originated, and where, incidentally, they have been solved.

It is a completely new factory ; and there is a world of difference between a brand new factory, standing on what were ploughed fields a few years ago, and staffed wholly by newcomers, and a factory which has undergone expansion, however great that expansion may have been. With an entirely new factory you have no leaven in the bread. The workers have no great interest in the factory ; they are there to do a job, and that is the beginning and the end of their interest.

This factory was laid out to do what was previously looked on as completely skilled engineering production, and to do it wholly with women labour, with the exception of male setters, the majority of whom are dilutees. The majority of the workers, both male and female, are not " directed " labour (to use the euphemism for conscripts), but are not there because they wanted to be ; they have been urged to do something until finally, in desperation, they thought they had better do so. I do not decry their efforts, but I think they could do more if they wished.

The products of the factory vary from items weighing less than an ounce to items weighing six or seven hundredweight. The vast majority of the machines cannot be set up for a particular job and

left running and continuously operated; in many cases they have to be broken down two, three or four times a week to go on to an entirely different job. Although the factory is on very high production level it is not a mass-production factory in the sense of one machine, one operation, with everything beautifully balanced.

I must qualify my statement that all the workers, apart from the setters, are women. There are several items of such a weight that they do not justify a mechanical lift of any sort, but which are too heavy for a woman to move up and down four or five times an hour all day long—items of, say, 20 to 25 lb. We have therefore a certain number of male operators to deal with these items. It is not a question of skill; my experience is that women acquire the necessary skill to do a job much quicker than men. I have not met anyone in the medium and heavy engineering trades who, once the prejudice against women has been broken down, has not said that he can teach a women of 18 to 30 to do a skilled job—a skilled *job*, not a skilled craft or trade—very much quicker than he can teach a man of the same age.

A high percentage of the women are married women, who are still keeping homes going, As chairman of an attendance board I have had to take people severely to task for bad time-keeping and absenteeism, but I confess it is a mystery to me how they do all that they are doing; how a woman can keep a home going, look after two children and her husband, do her shopping and housework and the thousand and one other things that a woman has to do, and in addition work a 55-hour week I do not understand, but the fact remains that many of them are doing it.

There are also many single people who have not married because their responsibilities are too great. It is no use thinking that people who are single can do what they like when they like; their domestic problems are often greater than those of married people. That applies particularly to women. If you let your humanity take control, the so-called absentee figures would go up enormously. The introduction of a satisfactory eight-hour shift system should materially assist those people, but there are other aspects of it which make many of them turn it down.

The next point is one which does not apply everywhere—the high percentage of workpeople in billets and lodgings, many of them with landladies who frankly do not want them, or who want them only for the profit they hope to make out of them, and who do as little as possible to make them comfortable. One result of that is that many workers prefer to go home each day, even if it means a 25-mile journey. That is a very real problem in the case of factories situated out in the wilds.

Another problem is that of canteen facilities. It is easy to

say that that can be solved by staggering hours, but there are difficulties in doing that. The canteen staff cannot work 24 hours a day; they cannot cope with a dozen mealtimes during the day. There is an organisation which puts on a concert, of varying degrees of attractiveness, two or three times a week, and everybody wants to hear it. Even the person who never visits a cinema and who would not think of paying sixpence to listen to a concert, when he hears that one of these factory concerts is to be given feels the whole culture in his soul welling up within him, and he is not going to be done out of it. Either you must persuade the concert party to give six performances or you will have constant complaints about the privileges which some people get in the matter of hours, and about the disadvantages from which others suffer. These are very real problems, and I should like to hear suggestions for solving them. In a factory with five or six thousand workers there are difficulties about the seating accommodation, and grumbles because the office staff squeeze out five minutes before the others and get the best seats.

Another difficulty is that of shopping facilities for married women. The fact that most of the local shopkeepers have been induced to accept priority cards has been of great assistance, but to obtain rationed goods is not the prime difficulty; the main difficulty is to induce the shopkeeper to keep you a little share—or, if you can possibly manage it, a little more than a little share—of the unrationed goods which come in periodically. We have not yet solved the problem of how a girl is to get a packet of face powder when it comes in only once a week in the middle of the day, and is snapped up long before she can get it.

It seems to me that the answer to many of these problems is to have three eight-hour shifts, if that can be conveniently arranged, because then for two out of the three turns everyone can have free time during the day; but this system involves other difficulties which are not easy to solve.

It is obvious, for example, that either you must have 50% more setters, if they are to work 8-hour shifts, or the setters will have to work 12-hour shifts. I have very strong views on the number of hours that people can habitually work, and I do not need a large and erudite Commission of learned professors to study the problem for six months to discover that when a man or women works he or she gets tired. Over a protracted period, it is impossible for setters to work 12 hours a day for six days a week. The 12-hour shift for setters, therefore, is not a solution of the problem. We shall need, therefore, a correspondingly increased number of setters.

Our factory is already so heavily diluted to obtain setters that I have grave doubts whether it can be diluted very much more, and in addition we are told that in a very short time everyone under

30 may be taken away, thus considerably reducing the number of skilled men available.

I prefer not to offer an opinion on the best times for shifts, because I do not know how to discover them Every hour of the 24 which I have suggested has been turned down for various reasons which seem to be good, of which meals and transport are the two strongest. The problem of meals arises in particular when a wife and her husband are both at work. If both are working in the same factory that problem can be dealt with, but if they work in different factories it cannot. Then there is the billeting problem. We endeavour to billet more than one person in the same house, partly because they will be bolder in getting what they want if there are two or more of them, and partly because misery loves company, and they can moan together in the evenings about the difficulties of the job. But if they work different shifts the landlady refuses to cook two sets of meals, and she can now point to exhortations to save fuel as her justification. It is impossible to arrange for every woman to have the exact shift she wants, because if you do it for one you must do it for all.

With regard to part-time work, if people can work only in the morning or afternoon they cannot do a night shift, which means that if you want the job carried on continuously you must have someone on permanent night shift, and there are many arguments against that. The problem seems to me almost insoluble.

Where the workers are on piece-work, as they are in my factory, it is difficult to persuade women who are newcomers to industry that they should share with their colleagues. I have the greatest difficulty with two shifts in getting them to book together, and when three women are concerned it seems to me hopeless. Each one is convinced that she is carrying her opposite number. That feeling is not confined to the female sex, or to people who operate machines ! But, having convinced themselves of that, they are not prepared to make a collective booking and share out the piece-work price. With short jobs, taking, say, half-an-hour the girl who is knocking off will not part-finish a job, because she thinks her opposite number will get the benefit of what she has done. She may rush one off to finish it, and then it may have to be scrapped. If there is that difficulty with 12-hour shifts, it is possible that there will be more of it with 8-hour shifts, and I should like suggestions on how to overcome the difficulty.

Then there is the problem of A.R.P. facilities. These are not in fact much used, but with 8-hour shifts it is obvious that the A.R.P. facilities must be increased, and in congested areas that may be a real problem.

I am not prepared to offer many suggestions regarding the problem of looking after children, except to say that all the attempts

which I have made to set up any form of nursery or creche have been a dismal failure. It seems that many of the people who said that they had children when they wanted to get away early disposed of them under somebody else's gooseberry bush when they were asked to produce them, while others did not like putting their children into these biggish " professional " nurseries, if I may use the term. They do not mind leaving them with the woman next door or with a relative, but when they see a nurse in uniform on duty they do not like leaving their children there.

The repair and maintenance of machines I have put down as the last of the difficulties, and I do not think it is so important as many of the others ; I feel that I could deal with that problem if I could overcome most problems of the eight hour shift.

I shall be surprised if my difficulties are not, to a greater or lesser degree, those of everyone else present, and I shall be very pleased to hear any suggestions which may throw any light on their solution.

MR. THOMAS : Mr. Hobbs's problem is a very real one, and a solution for it has been sought by many firms engaged on essential work who want to employ their machinery and equipment to the fullest possible extent ; but I maintain that the three-shift system is not possible unless the Government use to the full extent the powers entrusted to them. To find the extra labour for the three shifts means increasing the available labour to the extent of nearly 50 per cent. I think that the Government should conscript all men up to the age of 65 and all women up to 55 so as to provide this additional labour. Secondly, the Government should tackle seriously the problems of feeding facilities and nurseries. It would be a good thing if mothers could leave their children in the aid or welfare department of the factory. Thirdly, the problem of transport must be solved, and without Government help I do not think that much can be done there.

MR. CROOK : I am a visitor, not a production engineer, but in my industry, glass bottle manufacture, we work 168 hours a week, so that we have had experience of this problem in peace-time. We used to work with four 42-hour shifts, working 7-3, 3-11 and 11-7, the workers doing three days and then having a day off, and everyone was satisfied. After the war broke out came the need to change to three of shifts 56 hours, in order to conserve man-power, and then we had the air raids on London, which meant changing the hours of 7 a.m., 3 p.m. and 11 p.m. because of the raids at 11 p.m. and the difficulties of transport. The hours were therefore changed to 6 a.m. and 6 p.m., with a 12-hour turn. That was dealt with first of all by having four shifts, working a day shift, having a day off, working

a night shift, having a day off, working a day shift and so on. We have now cut that down to three shifts, and they work two day shifts, come off at 6 p.m. for 24 hours off, work two night shifts, coming off at 6 a.m. and having 48 hours off.

When we changed those shifts we discussed whether it would be better to work three eight-hour shifts, but that would have entailed changing shifts at 6 or 7 a.m., 2 or 3 p.m., and 10 or 11 p.m., and owing to the raids it was not possible to consider changing at 10 or 11 p.m. Since that time, another factory with which I am associated has gone on to the continuous production of engineering parts, and they are using the three-shift system, 6-2, 2-10 and 10-6, and they find great difficulty in keeping that going; first of all in getting the shifts worked, and secondly in getting the change-over at 10 p.m. The recent alteration of the evening transport services has made the 10 p.m. change almost impossible; it is necessary to let people go at 8-30 or 9 p.m., and so on, to catch their last 'bus. We have had meetings with the L.P.T.B. to try to persuade them to put another tram on, but they raise difficulties; they say "Who is going to take the tram driver home?" and so on.

My point is that this system of working 12-hour shifts can be employed to work a lesser number of hours a week than the average of 56. There is a booklet called "The 'C' Plan," by a Mr. Clay which gives a system of working in which two shifts only are worked but eight people are used to do three people's jobs, and you get an average of 52½ hours per person by working 10 hours a day. You work a 10-hour shift both day and night, total of 140 hours a week. That meets Mr. Hobbs's requirement of 135 hours, and instead of having to find 50 per cent more labour than he would have to find only 33⅓ per cent., or something like that

The other method of doing it is to put it on the basis that we already have, of three operators for one machine, but instead of working from 6 to 6 work only 10-hour shifts, the day shift coming on at 7-30 a.m. and finishing at 6-30 p.m. and the night shift coming on at 7-30 p.m. and going off at 6-30 a.m.

The advantages claimed for these plans are that you work every week-end, and every worker gets time off during the week, which solves the shopping problem. We have recruited numbers of and we find that the hours they get off enable them to do their shopping. Secondly we find that working 12 hours as against eight means less transport; both cost and amount of transport are cut down by 50 per cent.

Mr. Hobbs has dealt in a very human manner with these human problems, which are the main problems to be faced; they give more trouble than any question of rates paid.

In reply to Mr. Thomas, it is no use trying to put everything

on the Government. Everything we have done has been done despite Government help, or completely without it.

We have a number of men whom the Man-Power Board wants, and we have to replace them with women. The labour exchange says "There are no women in the neighbourhood; why do not you advertise?" We have advertised making the advertisements slightly humourous, and we are getting results; we find we can draw on a reserve of married women who are coming forward for this work.

I agree very heartily with almost all that Mr. Hobbs has said. We meet the same problems as he does.

MR. WITTON: I feel that there is no case for three shifts, save in exceptional circumstances. On the one hand, we have a definite shortage of labour; we can hardly get sufficient labour to fill the shops. If we have three eight-hour shifts, it has the effect of including one extra meal, which may be an hour or half an hour, and we lose quarter of an hour when the shift begins and something under quarter of an hour at the end. That makes a total loss of 1½ to 2 hours, reducing the 24 hours to, say 22. Now, two ten hour shifts will give us 20 hours, and, bearing in mind all the problems involved, my company feel that two ten-hour shifts are the answer.

The other difficulty with three eight-hour shifts if that one shift probably starts at 6 a.m. and another at 10 p.m., and for those shifts it is almost impossible to use married women, particularly if they have children. I feel also that the loss of efficiency in ten hours is much less than the loss in twelve, and we know from peace-time conditions that five hours is a reasonably efficient period for continuous work. On some three-shift systems, in addition to the meal hour there is another break for tea, which means a further loss. Bearing in mind the shortage of labour, there is very little case for three eight-hour shifts.

MR. HOBBS: I agree that at the moment we cannot get enough labour even for two shifts, but I sympathise with Mr. Thomas's suggestion that we should bring the people in to do it, because there are the people available if they were brought in, and I think we should bring in enough to make the eight-hour shift possible

The advisability of 12 hour shifts depends on the product. In some of our operations it is almost imperative from a technical point of view to operate a continuous shift, and in some cases the 8-hour shift is recognised as a technical necessity. That is where Mr. Crook has the advantage over many of us, because where the need for continuous shifts is well recognised there is not the same opposition to them. Most of the engineering industries lack that advantage and some of the men are even inclined to say "You would not let us work at all five or six years ago; why should we work 24 hours now?"

I am completely opposed to long hours of work, and I am not clear what Mr. Witton means by his ten hours. Does he mean an eleven-hour shift with a break of one hour ?

MR. WITTON : Yes, ten hours of work.

MR. HOBBS : That is what I am doing at the moment. There is much in what Mr. Witton says about waste time. I have overcome some of the difficulty by giving them a cup of tea in the morning and afternoon. There is no break ; tea-trays are pushed round, and we get this done (after a terrific argument about the status and dignity of labour) by the crane drivers. There are very few operations which cannot be kept running while a girl " takes it easy " for ten minutes and has a cup of tea and a bun. There is, of course, waste of time at meal times, but I regard that as an insoluble problem.

MR. LANE : We are a London firm who, leaving part of the factory in London, had to take over a works in a provincial town 150 miles away, and we have met the difficulty of billeting men, and some women, brought from London to this town, particularly when there are two in the same billet and you cannot change one shift without the other, and then, when you change the other, you find they have a friend whom they want to bring over as well. Our difficulty to-day, however, is to get sufficient women to fill our day and night shifts. We are running at least a 75% night shift, but with absenteeism 15 to 20 per cent, and much of it is put down by the doctors as " nervous debility," with a recommendation that the girl is suited only for day work. We do not know whether eventually the night shift will have to cease owing to the difficulties.

We have part-time workers for the morning shift and for the afternoon shift, and we have a third part-time shift from 7 to 11 p.m. We appreciate that those who come off at 11 p.m. must be living within walking distance, but we have a number who do so, and that helps us to make better use of the machines used by part-time workers during the day.

We also have difficulty due to shortage of setters. I have studied the " C plan " mentioned by Mr. Crook, but I think it is applicable only where you can group your machines ; i.e. where you have a group of, say, six machines, and so many people work on that group. We work a 55-hour week, with 5½ day shifts and 5 nights. Our biggest obstacle to three eight-hours shifts is insufficient labour, and we cannot work our setters 12 hours a day continuously. If we had the labour, we should certainly have eight-hour shifts.

MR. BEAZLEY : If Mr. Hobbs experiences trouble with billets, could not hostels be built ? They seem to overcome some of the trouble.

In the heavy engineering I think the best system is to have three eight-hour shifts, but there are several difficulties which have

not so far been mentioned. It becomes necessary to increase the supervisory staffs, going down to rate fixers and kindred grades, and there will be difficulties with day workers who are at present doing eleven hours and who will suddenly be reduced to eight, unless they are given some payment in the nature of a bonus, presumably based on the increased output due to the greater efforts of people working fewer hours. A third problem is caused by people with medical certificates, and by elderly people who cannot work at nights.

MR. HOBBS: The work of the minor supervisory grades, who are the people who have to be there for the whole time that the factory is operating, can be divided into two parts: (i) the actual minor administration of the shop, and (ii) supervision to see that the job is going on and that people are not wasting their time. If you work eight-hour shifts, it is possible to introduce a staggered system of supervision without detracting from the efficiency of the factory. If that is properly organised, those concerned will be able to do the first part of their work in reasonable time, and be able to do someone elses's supervision as well as their own. I think that the problem can be solved on those lines.

MR. CROCKER: I was associated for some months in the early part of this year with a factory very similar to that which Mr. Hobbs has described, and met with the same problems; and, like him, I found very few solutions for them. With regard to the vexed question of setters, I agree with Mr. Hobbs about the rapid acquisition of skill on the part of women where work of a simple nature is concerned, and I think the solution of the setter problem is for women to do their own setting after they have been on the job for six months. They will probably do it very much better than the dilutee male labour with which many of us are unfortunately saddled.

At the factory to which I refer we opened a shop for cosmetics, and it was a great success, cigarettes taking second place. I am convinced that that saved a considerable amount of what would otherwise have been lost time.

MR. BLACKSHAW: We are now prevented from opening a shop for the sale of cosmetics or anything else; there is an order preventing the starting of new businesses. We thought we would save time in our works by arranging for hair-cutting, but we were advised that we must close it down.

MR. HOBBS: The solution there is not to engage a hairdresser but to engage a labourer who by an extraordinary coincidence can cut hair.

MR. BLACKSHAW: That is what we have done; he is a capstan hand on the books.

MR. HOBBS: It is the same with buying and selling stuff. If

you operate your own canteen you are in a difficulty, but if your canteen is run under contract by a professional caterer you will probably find that he is covered for selling almost anything, from family bibles to lamp oil. Hairdressing and cosmetics are very important problems, and in the case of the male sex, so are the male counterpart of cosmetics, razor blades. When advertising for male labour it would almost be worth stating that razor blades are on sale in the factory !

I should welcome suggestions on the subject of nurseries for the children of women workers. I put out feelers, and I found that there were 276 women who had children who were being looked after, and I found that they did not want to bring them to the factory. I am certain that if I had installed the facilities, advantage would not have been taken of them. One difficulty is concerned with transport. The factory is dependent on a 'bus service. The average woman is more than equal to a man in a 'bus scrimmage, unless she is handicapped by having a child with her, and these women said " If we brought our children with us, we should never get on to the 'buses." I sympathise with that view, but I do not understand why they mind bringing the children to the factory. The point is very important, because more of our labour in future will be mothers with young children. The question is intimately bound up with that of the eight-hour shift, because, as has been pointed out, you cannot expect women to bring young children to a nursery at 7 a.m. or 11 p.m.

MRS. COHEN : It is fundamentally wrong for children to be brought to the factory, because at an early hour in the morning, especially in the winter, it is wrong to take a young child out into the damp air. I think the only solution is for nurseries to be provided near the actual residences of the mothers, and something may be done in that direction if individual firms will contact their local Ministry of Labour welfare officer. The services which these people can give vary from area to area, but they do want to be helpful, and the welfare officer in my area has said that the more information he can get from the firms in the area about the needs which exist, the better the help that he can give.

Mr. Hobbs says that the women do not seem keen to put their children in nurseries. In my area all the nurseries are full, and there are not nearly enough of them : the welfare officer is exercising pressure on higher authorities to get a new one built. In the meantime, there is a possibility that the normal policy of the Ministry of Health with regard to foster-mothers may be altered for the time being, and arrangements may be made for a special register of women for the day-time minding of babies and young children in the area to apply temporarily, owing to the fact that the nursery will take some time to build.

With regard to the problem of using part-time women on the three-shift system, I know of one firm which instead of employing these women for half a shift employs them for a whole shift, but only on three days or nights in the week. One firm in my area employs them for three nights a week. They have to have two women to cover one job, but I understand that it works satisfactorily. I think that principle could be applied on the three-shift system to any of the three shifts.

MR. HOBBS: That is a very valuable contribution. The second point is one which I have been considering for some time, but the difficulty lies in the question of piece-work. The system described is that of using people part-time during the week and not part-time during the day. I have put out feelers to see what the reaction to that would be, and I have had this reaction regarding piece-work payment. In our factory such payment is direct and individual to each person, and not an all-round bonus on output for group, shop or factory. You cannot get two girls who are working the same machine and doing the same job to agree to our saying "Between you, you have booked a value of £6 during the week and so you shall have £3 each." Each will say she ought to have £3 10s., because she has done more than her colleague. If people are brought in for two or three days a week it will involve questions of that kind, and involve tremendous problems on the clerical and booking side. I think, however, that it is worth persuing.

We should like to ask the speaker whether she thinks the nurseries should be large or small. I find that women have an inherent dislike to anything which savours of an organised institution, and I feel that the nursing uniform frightens them away. I feel that if a women can take her children to what I can best describe as a "motherly old dear," who may not be versed in the finer points of looking after childfen but who has probably had a dozen herself, they will do so, and if she looks after half a dozen or so in a small place the mothers are quite happy about it; but when they see a large, hygienic building with white tiles and a white floor, and a super-efficient-looking woman who regards them superciliously, they do not like it. If you go in for large nurseries, run on the best scientific lines, I do not think you will do as well as with a larger number of small places, run with a bit of homely dirt about them.

MRS. COHEN: I agree that a very large nursery is undesirable for two reasons. One is that women hate anything of an institutional type, and the other is that you will not get the necessary distribution of the facilities. You need to have them well distributed over the area from which the women come. On the other hand, it is unwise to have units which are too small, because then the oper-

ating costs are greatly increased. I think you can get hygiene, good feeding and good organisation, given the right people in charge without giving the parents the idea of an inhuman machine.

I have noticed a change in the last six months in the attitude of mothers towards nurseries, and many of them in my own factory have of their own accord put their children into them, although a year ago I think that they would not have done so. I think that that is chiefly due to neighbourly talks between women ; one woman will do it and then tell others how her child likes it. I think 15 to 20 children is the right size, and then no woman will have to go more than a ten minutes' walk to a nursery.

MR. BURNETT : With regard to the problem of payment, I do not know what organisation Mr. Hobbs has in his shops, but I should think that he might be able to employ shop clerks who at the end of each shift would record the actual work done by the individual operators, so that the payments to them would be correct. That should prevent arguments between one shift and another as to how much each had done. With regard to indirects who are working on day work, at one factory we had a system by which we assessed the amount of indirects required for a particular shop. We set as many time-study men as there were indirects in a particular shop, and they made a study recording during the day the total movement and amount of work done by each indirect, and that was plotted so that we knew the total amount of effective work done by the indirects in the course of a shift. We could then say that for a certain output the amount of indirects required was so-and-so, and then, by reducing the number of indirects to normal, we could say that, whatever the production efficiency of that department was, so the indirects must proportionately have increased their output, and it was quite fair to pay them the average bonus of the particular shop. That tends to cut out the problem of the direct operator earning too high a bonus and the day workers getting a flat rate.

I think we must take a broad view of this whole subject, and not confine our attention to the problems of an individual factory. Mr. Hobbs has mentioned many of the difficulties in running a three-shift system, and the difficulties experienced with two shifts will be enhanced with three, so that I think it would be right to say " The amount of the increase we are going to get from the individual operators is small, and the 50% increase in labour is not warranted by it ; therefore the labour which would be drawn on for a three-shift system should be dispersed among other factories which are suffering from a shortage of labour."

MR. HOBBS : The first point which you mention is something which we actually do ; it is a question of taking the daily output

and the names of the people who do it. The clerical staff employed are known as " work takers," a title which is self explanatory. The point, however, is this. You get what is really a weekly return taken daily for the output of each individual. If you wanted to take that several times a day you would have to handle such a peak load over a short period of about half an hour that you would want a very large clerical staff to do it.

One other problem which has not so far been mentioned is that of defectives and scrap. One of the best ways of dealing with defectives when operating piece-work is to have an inviolable rule that unless the operator and the setter can prove that something has gone wrong or that they have had incorrect tooling or gauges, or whatever it may be, they do not get paid for it. If you have two or three people operating on one job, whatever shift you go to about defective work you will find that it has always been done by the other shift. Defective work has to be tied down to the individual shift. If the position is watched, and active steps are taken, it is surprising how much defective work, due to pure carelessness is cut out. You cannot blame a girl who is operating a capstan machine turning out ten or twenty things an hour for doing a hundred of them defective ; the people to be blamed are the inspection staff and the shop staff. You cannot blame the operator, but if you have an inviolable rule of no payment for defective-work the operator will make sure that the first half-dozen to come off are all right, before going on to any more.

This question of payment is also bound up with the time it takes for the finished article to go through the shops. If you have a quick run through of large quantities of components you can watch the position fairly accurately, but if you have a big finished article, made exclusively in the factory, and taking, say, ten weeks altogether involving thousands of operations, it requires an enormous amount of clerical staff to keep check on it, and when there are three shifts instead of two the staff has to be increased in geometrical rather than arithmetical progression.

MR. BURNETT : I think that that is the crux of the problem. If your organisation allows you to have 100% operational inspection you can clear things up at the end of the shift.

MR. HOBBS : You can, I agree, but it depends on the complexity of the operations which you are doing. It would require a large inspection staff and they would be wasting a good deal of time waiting to do their work ; a very large number of inspectors would be required to deal with the peak loads.

MR. WITTON : You are bound to have a compound, or you will probably have a compound, in which the work is placed which is done during a shift, and then the next inspection shift can inspect it.

MR. HOBBS: You cannot carry products weighing several hundred-weight out to a compound and back again.

MR. WITTON: No, but you can have the compound at the end of the machines, so that anything which went through the capstan section, for example, would come from the capstan section to the inspection section for the capstan section, and then be moved forward to the next section.

MR. HOBBS: Items which can be handled on push trolleys or trucks are taken in each shift to an inspection compound. The bigger items are dealt with as far as possible in the vicinity of the operations. When you have something which is operated on by twenty or thirty different types of machines, each one demanding an inspection, it is very difficult to have a compound to handle these on each group. You are in danger of reaching a stage where you can do no production because all the room on the shop floor is taken up with ancillaries.

MR. TREVOR: I think one of the answers to Mr. Hobbs's problem on the point just discussed is more training. If he trained the operators to do some inspection work, so that they could use gauges and so on, it would help to solve the problem of inspection.

Regarding the three-shift system, I think the biggest problem, apart from setters, is that of reduced earnings for those who are working on the two-shift system at the moment. I do not know what Mr. Hobbs proposes to do about that.

MR. HOBBS: The theory which I put to them is that, due to the shorter hours, they can work harder and earn as much money in eight hours as they used to earn in twelve.

MR. TREVOR: Have you setter-operators in your factory?

MR. HOBBS: No; I have been careful not to have them.

MR. TREVOR: I suggest that that is another way of overcoming the difficulty in that respect.

MR. HOBBS: That is a very contentious matter, because of the agreements between the trade unions and the employers. On piece-work, a woman in the engineering industry gets 75% of the rate when she is working under a skilled man or dilutee who does the setting, and the rate goes up progressively to 100% when she is entirely on her own. If we try to differentiate between the girls in a shop, regarding one as a setter-operator and another as an operator only, it leads to a great deal of argument and petty jealousy, so that it is best to avoid it.

We once introduced a system dividing inspection into three groups, simple, medium and difficult. There was no argument about the simple and difficult, but there was a great deal of argument about the intermediate group. It is a question of policy as to whether what is gained by the introduction of setter-operators is not lost by the discontent and disorder caused in the shop. I

think that it is. It is always difficult to sort out people and pay them what you think on merit they deserve, and it is much more difficult to do that with women then with men. No woman will admit that the woman next to her is better than she is. A man will sometimes do so—not very often—but a woman, never!

MR. STUCHBERRY: It seems to me that the first question to ask is the well-known one, "Is the journey really necessary?" When it is proposed that we should put on about 50% more labour for about 23% more hours, that is a legitimate question. However, I think it may be taken from the discussion to-day that the journey really is necessary; there seems to be a general opinion that there are distinct advantages in operating three shifts. It brings the number of hours per person more into line with the general level set by the Ministry of Labour; it provides continuity, and presumably it enables efficient tool-ups and so on to be continuously operated. It seems also to be a conclusion of this meeting that what has been done has been achieved despite Government assistance. It would seem very desirable, therefore that the Government should lay down some policy as a guide to how far we can go in overcoming these difficulties.

In the business with which I am associated we have not found it necessary to operate on a three-shift basis throughout a factory, but we have on many occasions operated on a three-shift basis in departments. That creates certain difficulties with regard to payment, but it reduces very considerably the other difficulties to which Mr. Hobbs has referred. I think that wherever possible the change to a three-shift basis should be gradual; if possible, the business should be departmentalised, so that part-time labour and the like can be used on the operations which are essentially day-shift, leaving the remainder of the labour to be divided between the work which can be continuously operated on a three-shift basis.

We ought to see whether the necessity is sufficiently great for Government policy to back it up, because without Government assistance we are not likely to get the amount of labour needed, nor the additional skilled labour for use as setters or with sufficient aptitude to be trained as setters. We are faced with a further drain by the calling up of the younger men, and I think the Government should decide how far they want shift work, with its advantages and how far they are prepared to do without it. Without their assistance, I am sure that nothing can be done.

MR. MATHERS: During my rather short experience, I have noticed a tendency to go in more and more for piece-work and payment by results, with a corresponding increase in the amount of clerical labour involved and in man-hours on the part of the clerks. I suggest that we should try to get back to more universal day-work

in the hope that it will save a good deal of clerical labour, and try to get output through our supervisors or through the psychological approach. In my own factory we do very little piece-work indeed. There has been a tendency to increase it, but many people are against it on the score that if we increase the number of jobs which we do on piece-work we shall have to engage a bigger clerical staff. It is a fairly small factory, and that point is important.

MR. HANSCOMBE: Mr. Hobbs has not yet stated whether he plans on groups or on machines, and that seems to me to be a fundamental point about which we should be told before we attempt to deal with the problem of setters. I suggest that Mr. Hobbs should consider the policy adopted when running conveyors, the policy of having what are termed relief operators, and apply it to setters. As an example, there may be a group of six to ten women under one setter, and you may have four or five groups of operators. The setter works a 12-hour day for five days, and then the relief setter takes over. The operators, on the other hand, work the three-shift system.

MR. HOBBS: What does the relief setter do for the rest of the time?

MR. HANSCOMBE: You could arrange a 10-hour shift, the relief setter then taking over for another two hours and carrying on into the next shift. Before I could really answer the question, I should need to know whether Mr. Hobbs was planning in groups, and to know the number of setters involved.

MR. HOBBS: On the question of day work *versus* piece-work, in a small organisation, where you know exactly what is going on and what everyone is doing, doing individual jobs with a short run, you will probably get very good results with day-work; but for the rest, I have no doubt at all of the virtue of payment by results; it doubles or triples the output. In a big factory, the clerical work is not so big as may be imagined, and much of the work has to be done in any case as part of another job: the planners, for instance, have to work out the cost of the job when doing planning.

On the subject of relief operators or setters, we have a somewhat similar system to that mentioned by Mr. Hanscombe, which we use for dealing with absenteeism. If the rate of absenteeism from all causes is down to 10%, you are not doing badly; but to deal with that, and to prevent half a dozen girls standing idle for two or three hours because the setter has not turned up, we have a certain number of "floating setters," and for every ten setters we have one floating setter. He has to be carefully selected, because he has to be able to turn his hand to anything with reasonable success. We try to do the same thing with the operators, and to have 10% of operators who "float." They will usually be busy.

But if you have a relief setter doing two days a week, what do you do with him for the other five days ?

MR. HANSCOMBE : They might be occupied on maintenance work and other work which is the normal work of a setter.

MR. BURNETT : What would be the effect on the balance of your plant of operating three shifts. I imagine that the balance between your day and night shifts at the moment is considerably out, and that in effect you are operating the night shift more to keep in step those machines which are out of balance with the rest. That, at any rate, is my experience ; usually the night shift operates on those machines which are heavily burdened, in order to keep the remaining machines fully occupied on days. What effect will it have on the balancing of the plant if you change over to three shifts ?

MR. HOBBS : In the organisation to which I belong, this is one factory of many, employing in the aggregate on engineering production tens of thousands of operators. It is easy, therefore, to balance up the machines by mutual aid among the whole group of factories. Regular meetings are arranged at least once a month, and one's opposite number may be looking for work for his capstans, and when you have a dozen factories engaged on a wide variety of engineering work there is sure to be someone whose capstans are being overwhelmed, and so the balance can be obtained. I realise, however, that that does not answer the question so far as an isolated firm is concerned.

MR. LONG : In the case of many firms of medium size, I find that the most suitable arrangement is regarded as the 11-hour shift, working two shifts, finishing work on Saturday morning and having the whole of Sunday off. For the first half hour on beginning work and for the last half hour before knocking off, the curve of efficiency is always lower, and with three shifts that amounts to an appreciable total each week. On the whole, I think it is better to have two shifts instead of three, and that will help to solve the labour problem as well.

MR. HOBBS : One of the reasons for wanting an eight-hour shift is the belief that people will work more efficiently for eight hours than for ten or eleven. We have to make up our minds whether the controlling factor is labour or machines. When people concerned in making a product get together, they usually come armed not with lists of human operators but with lists of machines which they want. If it is machines which are the controlling factor, the longer we can work those machines every week the better ; we should get the human beings from somewhere to operate the machines. I think an 11-hour day, with perhaps an hour and a half to be added for travelling, is too much for efficiency and so I should like to reduce the hours by increasing the number of workers.

MR. BURNETT : I suggest that we should endeavour to establish in some way or other which is the problem to-day : is it machines or is it personnel ? Personally, I am firmly convinced that it is not machines but personnel, but, until that point has been settled, we do not know which way we should turn to get greater efficiency. My own view being that the problem is primarily one of personnel, I think we should increase the number of effective hours a week per operator rather than try to utilise the available plant to a maximum efficiency. I think we have passed the stage when the machine tool was the problem.

Mr. Hobbs says he wants to operate three eight-hour shifts, giving 135 hours per week. I fail to see how he will get a 135-hour week unless he works a 6½-day week, because on an eight-hour shift the maximum possible output will be seven hours per shift.

MR. HOBBS : Seven and a half ; there will be a half-hour break, not an hour.

MR. BURNETT : I think we have to accept the fact that we have always to take off quarter of an hour at the beginning of a shift and quarter of an hour at the end. That means that the optimum is seven hours, which means a 126-hour week.

MR. HOBBS : I am afraid you must accept the number of hours that the factory is supposed to be working, and base your argument on that. If you want my figures for the number of hours that the people in the factory *are* working, they would be much lower than yours !

MR. BURNETT : When we are trying to decide what steps should be taken, I think we must look at realities and say to ourselves : " What are we going to get out of this new procedure, as compared with what we have been getting on the old ?" That is the problem, not what shall we get in theory. But we must establish which is the problem of the day, machine tools or labour.

MR. PARKER : The crux of the problem is setters. When we were blitzed in London, eighteen of us (including the clerical staff) went up north, and in twelve months we had a thousand people working there. We did not get any setters ; we had to train them. I made a good automatic setter out of a cabinet maker ; another setter had been a printing engineer. The men who make the best setters are those who have used tools in another trade. I find that very often the people whom we get from Government training centres as setters are not suitable for the job.

Everything depends on the skilled men who act as setters. To get them to train others you have to break down their prejudices, and it helps in doing that if you give them certain provileges and status. Do not make them scramble for the clock at the same time as the other people ; give them a clock of their own. Give them a lavatory and wash-place of their own. Once they are willing to

help, they are the best people to train setters. I think Mr. Hobbs's main problem is not having enough setters: if he had enough setters, he would be able to work three eight-hour shifts.

MR. HOBBS: Shortage of setters is only one part of the problem. Most of my setters are dilutees who have been trained on the job. I agree with Mr. Parker entirely, except that I do not think that the granting of privileges should go as far as to make people visualise themselves as little tin gods. It is possible to go so far as to make a man feel that his mere presence in the shop is all that is required of him. My method of according privileges takes a more material form, the form of extra money. In my opinion, setters are paid fairly handsomely if the output of their group is reasonable, and we do not have many complaints on that score. I agree entirely that a man who is accustomed to using tools makes the best setter probably cabinet-makers and pattern-makers would be among the easiest to train for productive engineering work. People who have been doing clerical work are often afraid of the machine to begin with.

The CHAIRMAN: After listening to the discussion, I have come to the conclusion that almost everyone seems to have the same problems as Mr. Hobbs. He seems to have settled some of theirs, and I hope they have settled some of his. Whilst we may go away without having settled the real problem—which, as Mr. Burnett said, is whether personnel or machines are the governing factor—I think we shall all feel that we have not wasted our afternoon.

MR. STUCHBERRY: I have much pleasure in proposing a cordial vote of thanks to Mr. Hobbs for opening the discussion. In doing so, I should like to point out that, at the recent General Meeting of the Instutition, the Minister of Production remarked that we had passed the stage at which machine tools were the bottle-neck, and said that labour was now the bottle-neck. I think that substantial arguments have been put forward this afternoon in favour of the view that the three-shift basis would in fact increase efficiency, even if it reduced the actual number of hours which people now spend in the factory.

The vote of thanks was carried with acclamation.

MR. HOBBS: The whole situation this afternoon has been the reverse of what is customary at meetings of this kind. I have not come here as an expert to tell you things; I have brought to you the problems of a practical man who feels that he is not making too good a show in some directions, and I have had some very valuable contributions towards the solution of my problems. In thanking you for this vote of thanks, therefore, I should like in my turn to propose a vote of thanks to you.

VISIT TO ALFRED HERBERT LIMITED MECHANISED FOUNDRY

By the Institution of Production Engineers, Coventry Section, on September 25, 1942

Talk by Mr. W. G. Morgan, Foundry Manager, Alfred Herbert Ltd
Chairman: Mr. H. D. S. Burgess, M.I.P.E.

MR. BURGESS—Gentlemen: I am sure those who were fortunate enough to go into the foundry and see the mechanised part must have found it interesting. I propose to ask Mr. Morgan, Foundry Manager, of Alfred Herbert Limited, by whose courtesy we are here tonight, to give us an informal talk. I have great pleasure to introduce Mr. Morgan.

MR. MORGAN: Mr. Chairman and Gentlemen. I have not prepared a formal paper for this evening as, at the present time, I think it preferable to direct our attention to understanding each others' difficulties.

We are all apt to be critical and cynical if things do not go the same as before the war, but everyone must adapt themselves to changed conditions and changed materials which the war has brought along.

Tonight I would like to draw your attention to some of the difficulties foundries in general have had to face, so that some of the problems which might appear due to carelessness or inattention may come to you in a different light.

The labour situation is one which everyone has had to face and would provide a topic for many hours discussion, but perhaps we had better leave this rather too contentious subject.

However, in this connection I would like to point out that the skilled moulder or coremaker is usually only experienced and skilled on a limited class of work and often in one alloy such as cast iron, steel or aluminium.

It is important to appreciate this, for in these days when labour is frequently transferred from one end of the country to the other it is no criterion of man's ability or adaptability to a new class of work to say he has had ten or twenty years experience as a moulder in grey iron. For this reason purely numerical returns by Labour officials are oft n misleading.

Our main difficulties have been associated with the use of different if not always inferior materials.

The iron foundry in the last few years has shown a tendency to use low phosphoric irons, in an attempt to reduce porosity in intricate castings.

The production of low phosphoric irons has been made possible by the use of foreign ores. Consequent to the war, these sources of supplies became difficult if not eliminated. The Government reduced the quantity of ore imported and British low phosphoric ores have gone to the production of hemaetite pig iron for steel manufacture.

The alternative to the use of low phosphoric pig iron—usually denoted as refined irons, because the whole analysis is modified by a secondary refining process after blast furnace production—is the introduction of mild steel scrap to the cupola furnace charge. At the present time this steel scrap is also in short supply. When more than 10 per cent steel is used, modification of standard cupola practice is required.

The higher phosphoric British pig iron, 20 years ago, was in general use. It demanded a technique for running and feeding a casting, which was quite different from that employed when using low phosphoric iron.

Now, in addition to our other difficulties, we have to change right back from a practice which has been developed over the past ten years to an altogether different procedure, and that has meant that, not only the foundry executive has had to change his ideas, but the moulder has had to change his also. This is not easy, because the correct size and position of runners and risers on castings are something which a moulder learns slowly and he does not easily understand the necessity for changing it. This is due to the different shrinkage problems met with between high and low phosphoric irons. Gating and feeding is something individual on every casting. No two castings of the same size and design will cool and solidify in the same way, unless the same type of mould *i.e.*, green or dry sand, is used together with similar pouring and feeding conditions. There is no doubt that some of the apparently inexplicable difficulties, troubles and defective castings to-day, as between one foundry and another, are due primarily to lack of experience and the use of an entirely different type of iron.

Another problem is the necessity of producing a casting which can be machined at high speeds—something that can be cut easily and yet is perfectly sound. These two factors are opposed. To strike a balance, it can only be arrived at if there is a mutual understanding of each others problems. Varying hardness in the different sections of a casting are inevitable and may not matter. Foundrymen must avoid porosity however, in uneven sections. This may call

for a change of moulding technique and is one of the main difficulties at the present time in getting foundries who have never made a particular type of casting to change over.

The machine tool trade are having to buy from a lot of people who have made nothing but textile or other light castings. The exterior may be good, the skin and shape may be good and the general structure of the iron appear satisfactory, but after many machining operations, one finds, perhaps, a patch of porosity. The foundry does not know about it. All normal precautions have been taken. It is a serious problem for the machine shop because it immediately upsets both planning and production. The foundry must and does overcome these difficulties by co-operation between the experienced and inexperienced firms and intensive education and supervision. This is one of the few bright spots of war time conditions—that a freer exchange of experience, necessitated by the forced handling of an entirely new class of work, provides a broader knowledge of the science and art of founding.

Turning to the non-ferrous foundry we meet similar problems. Since the fall of Malaya, we have lost our main source of tin and that has brought about a new set of conditions. Whereas people were making gun metal or phosphor bronze castings using between 9%—14% tin they are now producing copper alloys with little or no tin. The technical procedure is again different and considerable experimental work is necessary by the foundry. Shrinkage and moulding difficulties are such as have never been met with. The foundry manager must educate his moulders and furnacemen. Now furnacemen are not metallurgists. Casting temperatures are not found in text books and are not easy to convey from one foundry to another. The non-ferrous foundry is called upon to make castings in alloys of copper silicon, copper aluminium or copper manganese.

Whilst the physical properties of some of these alloys are no doubt very attractive to the engineer, I can assure you their production in the form of castings has given many a foundry manager a big headache.

In addition to the exceptional shrinkage problems met with, these alloys call for most critical melting and pouring conditions.

Here is a case for the utmost co-operation between designers and foundrymen, if economical results are to be achieved.

Restriction in the use of tin has also brought about a change from high tin to high lead bearing metals. It may not be generally recognised that these are liable to segregation of lead and consequently production methods have had to be designed to ensure that solidification occurs sufficiently rapidly to prevent this segregation taking place.

In the light alloy field, which is now more or less restricted to aircraft work, problems have been chiefly concerned with the mass production of highly intricate castings to very exact dimensional accuracy and metal soundness, and those who have been privileged to see the developments which have taken place will appreciate that here foundrywork must be an exact applied acience.

There, also, the call for increased production has meant that a large number of men have had to be transferred from Foundries who have probably been making iron or bronze. Again, the men must be educated. It is not a question of sending a man to school or giving him a text book. It is a question of continually supervising every detail of work made, and, as scrap inevitably comes along, tryin to show the man where he has gone wrong.

In the non-ferrous foundry there are a larger number of fuels used for melting than in the iron foundry.

Whilst various designs of coke fired crucible furnaces are widely used, oil and gas are preferred by many because of their greater flexibility.

The most easily manipulated fuel oil is diesel oil but, in the interests of national economy a home produced substitute in Creosote pitch is now widely adopted.

Diesel oil will remain liquid without preheating—creosote pitch on the other hand needs to be kept at 90° F. to remain in a liquid condition at all and before vapourising at the burner is must be heated to 200° F. Specially insulated storage tanks and pipe lines are necessary. On cool mornings it is a difficult fuel to light. Below 150° F. it refuses to ignite.

This has taxed the ingenuity of the furnaceman and in the winter time has upset the normal flow of production.

Finally, I would like to comment on a factor which is very much to the fore at the present time, namely, the upgrading of labour. Foundry work in every operation requires a certain amount of experience, bu tthe skilled moulder is a man who needs to spend years at the trade to acquire the requisite ability. Attempts to introduce unskilled or even semi-skilled men to this grade are certainly doomed to failure. The alternative is the introduction of moulding machines, even if their full capacity is not obtainable, in order to use the available labour.

In connection with women coremakers, unless the work they are doing is of a simple repetition character, considerable experience and supervision is necessary. It should be borne in mind that, unlike a machined component, dimensional accuracy is only one part of the job and unless the whole core is constructed correctly it may subsequently break or produce a defective casting from one or more causes—which must be diagnosed from experience

because they are no longer existing in their original form after the casting is taken from the mould.

Well I have dealt with just a few problems incidental to castings and no doubt you will have others from your point of view which we could discuss.

Mr. BURGESS: I am sure we have listened to Mr. Morgan's problems with great interest and that you will have queries to put forward.

MR. DRANE: How do you arrive at a decision regarding the details which are suitable for moulding on the runabout?

MR. MORGAN: First of all the size of the job plays an important part—whether it will go on that type of machine and secondly the quantity likely to be required. If there is a minimum of twelve and it is likely to repeat, we put it on a plate.

MR. RILEY: The most important factor facing us to-day is TIME and when engaged upon varied production, time is of added importance, in-so-far that our flexibility depends upon the time of manufacture.

We frequently find that much valuable time is taken in the "weathering" of castings, and when a sudden demand is made for an article for which we have had no chance whatever of allowing for this "weathering" time, it is rather exasperating.

To quote an example, we weather the castings of a particular type of lathe bed for three months.

Can Mr. Morgan suggest any means of overcoming this difficulty?

MR. MORGAN: There is no satisfactory alternative to this "weathering." There are other means, of course. One is low temperature annealing, but when it comes to the question of lathe beds, the size of the casting is such that a very large furnace is necessary to do this annealing. Where it is possible to put castings into a furnace, because of their smaller size, we do carry out stress relieving by heat treatment. In the case of large lathe beds, however, it is an economical difficulty and "weathering" is a satisfactory as well as the most economical method to adopt.

MR. FIELD: Dealing with the question of gates, do you rely entirely on your pattern maker, or do you draw these out?

MR. MORGAN: No! The patternmaker has no say in the gating. Skilled foundry labour is employed on that job. In addition to making cast metal plates, he also moulds, casts and fits on gates and risers to pattern plates. He has specialised knowledge of this work.

MR. FIELD: Do you think, under continuous production—not small batches—that data could be collected and used for designing, rather than relying on the foundry? It amounts to planning.

MR. MORGAN : Yes. Providing it is done by a foundryman who understands the gating problems properly. Some firms employ such a man in the general Planning Department. He could also fix piecework prices. It does not lend itself readily in our case, in view of the large variety of castings we make.

MR. AVERY : How do you get the boxes back to the moulders on the conveyor system ?

MR. MORGAN : After knocking out, the empty boxes are placed back on the conveyor and drawn off on to the storage conveyor as they pass either of these two lines. They are then stacked according to size and with the pin parts also separated.

MR. BOYES : Do the boxes have to be man handled straight on to the machines ?

MR. MORGAN : Yes !

MR. DRANE : I presume every box has some given amount of time to cool on the moving track ?

MR. MORGAN : Yes. It is calculated that the minimum time shall be that required by the heaviest casting.

MR. BLACKFORD : What is the speed of the moving conveyor on which pouring is carried out ?

MR. MORGAN : Either 12 or 6 feet per minute according to the size of the mould being poured. These speeds are obtained by a two speed motor and controlled by push button at the pouring station.

MR. FIELD : Do you use a strainer core ?

MR. MORGAN : No. A combination of tinned steel plate under the runner basin and a spinning gate.

MR. CHAPMAN : Do you use a rotary mill ?

MR. MORGAN : No. Because we do not use a unit sand. We use both facing and backing sands. The backing sand is the only one that passes through the reconditioning in the plant. The facing sand is prepared separately in a Simpson mill.

MR. CHAPMAN : How do you handle spillage sand ?

MR. MORGAN : There are push button switches which control the whole of the sand delivery system from the main storage tank to the machines. A man on the elevated platform ensures that each moulder is given an adequate supply of sand and as hoppers are filled he stops the plant so that actually no spillage occurs.

MR. CHAPMAN : When moulders are moulding the sand falls around the machines. Do you use this sand again ?

MR. MORGAN : Yes, this is backing sand, and every fifth or sixth mould the man shovels it up. In designing this plant we did not consider it necessary to put a spillage conveyor to handle this small quantity of sand.

MR. CHAPMAN : Have you considered fume extraction ?

MR. MORGAN : Yes. It is a very desirable feature on mechanized plants, but it is not practicable to put it on our " U " shaped con-

veyor. Fume extraction can be conveniently introduced on the straight leg of an oval conveyor in a continuous plant.

MR. CHAPMAN: With the small moulds which you make in the mornings, does it not affect this if you have to wait until the afternoon before pouring?

MR. MORGAN: No. We have no difficulty. The only trouble which could arise would be if the temperature and humidity of the sand was too high. The only way to cool sand is to cascade it as much as possible. In our practice whilst the temperature of the sand at the knock-out is about 170° F., by the time it reaches the hoppers over the moulding machines it has dropped about 80—85° F.

MR. CHAPMAN: Do you lay cores on the roller conveyor?

MR. MORGAN: Yes. All coring and closing is done on the stationary conveyor.

MR. DRANE: Perhaps you would not mind mentioning the illumination.

MR. MORGAN: You may have noticed we have two systems—mercury discharge in the heavy and sodium in the light foundry. We find of the two, the best penetration is by sodium. By penetration, I mean the visibility down into a deep dark mould. The intensity of the light in the lower foundry is 15 ft. candles and in the top foundry 11 ft. candles, and yet at 11, it is still a better illumination. They are both cheaper than an equivalent degree of illumination by tungsten lamps.

MR. CHAPMAN: What is the life of the rubber belts?

MR. MORGAN: It is claimed to be about six years. A steel apron plate conveyor is better than rubber under the knock-out as red hot sand will definitely char rubber belting. There is a certain amount of searing occasionally, if there is no layer of sand between the belt and any hot castings which may drop through the grating. We have had this system for four and a half years and there appears to be no excessive wear.

MR. BOYES: Have you any method of ventilating the underground belt system? Is there any ventilation under the grating?

MR. MORGAN: Underneath the knock-out grate we have a steam extraction plant. It consists of diamond shaped ducts with slots opening on the underside and arranged transversely in the hopper under the knock-out grating. These ducts are connected to a powerful exhaust fan and provide reasonably decent work conditions for the men engaged on the knocking out.

MR. BOYES: Do you spray water at the knocking out stage?

MR. MORGAN: No, not as a definite operation. A certain number of moulds are left overnight. Those moulds, because the castings are left in all night, dry out and we do water this sand on the first inclined belt as a precaution against excessively dry sand getting through.

MR. ARNOLD : How often does sand circulate round the system per day ?

MR. MORGAN : One and three quarter times. We add to the system each day, in the form of facing sand, about 4½ tons, and there is about 60 tons of sand for the whole system. Waste adheres to castings as knocked out. We do not reclaim this sand, simply because the majority of these castings contain cores which are made from sea sand artificially bonded. This means that you revert to synthetic sand. Synthetic sand is a high silica sand, bonded with colloidal clay, *i.e.*, clay in an extremely fine state, which used to come from America but which now, because of shipping difficulties, is coming from Ireland or the West of England, and unless the plant is laid out to deal with that type of sand, it is impossible to deal with it in part.

MR. AVERY : At the right hand of the conveyor system were five tracks which did not match up with the main track. Why was that ?

MR. MORGAN : These tracks which are larger are serving two 24 in. square moulding machines and actually do line up with the moving conveyor by means of a quadrant conveyor mounted on a roller carriage, thus enabling the moulds to be transferred to the central knock-out.

The castings made on these machines average 56 lb. in weight and go up to 3¼ cwt. so that they are crane ladled and require about 30 minutes cooling time before being transferred for knocking-out.

MR. FIELD : I did not notice any conveyor from the core shop. How do you bring them from the core shop to the moulding shop ?

MR. MORGAN : All cores are ordered two days prior to requirements. The storage of cores is done in the core shop and small mouldings and large moulding machines have labourers detailed for fetching cores as required. They use specially constructed rubber tyred wheelbarrows.

MR. BURGESS : I do not like to close this very interesting discussion but I am sure we are all pleased to know there is no black magic in the foundry and that it is all a question of straight forward planning. What we have heard to-night proves this point conclusively. We are greatly indebted to Alfred Herbert Limited for the very interesting tour round the foundry and the discussion. This has been our inaugural meeting this season and I am sure it has been highly successful and will encourage the committee to go on with further meetings of this kind.

Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—*The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.*

EMPLOYEES, WORKMEN, APPRENTICES.

A Guide to Personnel Record-Keeping, by Frank M. Knox. (*Personnel, U.S.A., November, 1942, Vol. 19, No. 3, p. 540*).

Adequate personnel records are now more essential than ever. Without them, a firm may find itself in serious difficulties over wage stabilization, social security, seniority rules, or any one of a long list of similar regulations. An over-all guide to personnel records is presented showing which types are needed by firms of varying sizes, how economical forms may be designed, and how the personnel manager may determine what to omit and what to include on each.

GEARING.

Gears and Gear Cutting, by Allan H. Candee. (*The Machinist, January 2, 1943, Vol. 86, No. 38, p. 1006, 18 figs.*) *and* (*January 30, 1943, No. 42, p. 1162, 3 figs.*).

Properly cut gears, regardless of their size, will transmit a smooth flow of power in a wide variety of mechanical designs. Incorrect teeth; conjugate gear teeth. Generation determines profiles. A wide range of adjustments in a universal machine permits cutting a small " Zero " pinion.

Gear generation permits the designer to make desirable changes in tooth contours without the use of special tooling. Modified tooth is stronger. Shop layouts not needed. Bevel gear standards. The Gleason straight bevel gear system—revised in 1940—provides improved tooth design with standard methods.

MACHINING, MACHINE TOOLS.

Table of Wheel Recommendations. Centerless Grinding. (*The Tool Engineer, November, 1942, Vol. XI, No. 11, p. 96a*).

Material and operation. Abrasive. Grain Size. Grade. Bond.

MANUFACTURING METHODS.

Avro Lancaster, by Wilfred E. Goff. (*Aircraft Production, February 1943, Vol. 5, No. 52, p. 61, 29 figs.*).

Part II. Building the fuselage. Track assembly system. Wing-tips and wing trailing portion.

Machining Hispano Cannon Components. (*Aircraft Production, February 1943, Vol. 5, No. 52, p. 78, 21 figs.*).

Part II. The body and breech block. Special machining and inspection fixtures.

Wright Engine Production, by F. C. Sheffield. (*Aircraft Production, February, 1943, Vol. 5, No. 52, p. 89, 16 figs.*).

Part I. Special tools and equipment for accelerating the output of cylinder assemblies.

Photographic Templates, by E. C. Jewett and C. D. Tate. (*Mechanical Engineering, U.S.A., November, 1942, Vol. 64, No. 11, p. 787, 1 fig.*).

In order to use photography directly, it is necessary to photosensitize the template material itself. All difficulties of previous processes have been met by the development of " matte transfer paper," which consists of a projection speed emulsion coated on a temporary paper base at the photographic factory and shipped in long rolls to the user. This material is cemented, with the emulsion side in contact, to a previously prepared sheet of template stock by a very simple process. Requirements for reproducing drawings. Projection methods. Uses of the projection method. Contact methods. Uses of the X-ray contact method. Preparation of photosensitized material. Photocopying costs. The principal advantages of photocopying : (1) considerable time saving by the elimination of manual drafting and checking, and (2) the consequent economy.

Photographic Production of Templates. (*Mechanical World, January 8, 1943, Vol. 113, No. 2923, p. 32, 4 figs.*).

Some details of the new process used to speed-up aircraft production. An immense saving in time is effected in the design of tools and dies because the photographed drawings can be taken in any number and the details drilled on the metal plates which become templates. A raised floor is erected on which whole aeroplanes may be laid out in full scale, their contours sketched on the floor itself. To the loft then come stress analysts to fill in the details of such things as bulkheads, stringers, spars, etc. The drawings are transferred to white-coated metal sheets in full scale and then passed along the photo reproduction process. Craftsmen do not work from scale drawings in building fixtures, jigs, etc. In many cases these are built directly on the full scale drawings themselves, the workmen simply following the lines of the photographic print.

Finishing Sprayed Metals, by W. C. Reid. (*The Machinist, January 16, 1943 Vol. 86, No. 40, p. 1084, 3 figs.*).

Definite precautions have to be taken when machining, grinding and polishing metallized parts. Sprayed carbon steels sometimes form a hard ring adjacent to the ends of undercut section. High speed tools, speeds and feeds for machining sprayed metals. Recommended speeds and feeds for tungsten-carbide tools. Cylindrical grinding--wet. Cylindrical grinding—dry. Metallizing wires.

Cemented Carbide Manufacture and Applications, by A. Mackenzie. (*Wire and Wire Prod., October, 1942, Vol. 17, No. 10, p. 574*).

Cemented carbide dies for wire-drawing and pressworking, and for cutting tools.

(*Communicated by the British Non-ferrous Metals Research Association*).

The Foren Mill for Rolling Seamless Tubes Achieves Virtually Continuous Production, by E. W. Wrage. (*Trans. of A.S.M.E., U.S.A., November, 1942, Vol. 64, No. 8, p. 745, 8 figs.*).

The development of the Foren tube-rolling process, details of the first experimental unit, and the problems which required solution in making it commercially practicable. Operation of the present unit, which is based on straight-line production methods, is described. Automatic controls for practically all operations have been developed, which makes possible the reduction of personnel to a minimum.

MATERIALS, MATERIAL TESTING.

Federated Babbits " G " and " S " (Lead Base). (*Brochure, 1942, p. 8*).

The nominal composition of " G " babbitt is 12.5 per cent Sb, 3.0 per cent As, 0.75 per cent Sn, remainder Pb ; " S " babbitt is 15.0 per cent Sb, 1.0 per cent As, 1.0 per cent Sn, 0.5 per cent Cu, remainder Pb. Details are given of mechanical properties and chemical and mechanical bonding procedure. These bearing metals are claimed to be suitable for replacing Sn-base babbitts in all types of precision bearings ; they cost at least 50 per cent less.

(*Communicated by the British Non-Ferrous Metals Research Association*).

How to Select Efficient Cutting Tools, by L. J. St. Clair. (*Iron Age, October 1, 1942, Vol. 150, No. 14, p. 60*).

A chart giving tool materials suitable for light, medium and heavy cuts on various materials including non-ferrous metals, together with a description of " Kut Kost " tool material which contains cobalt, tungsten, chromium, and boron carbides, is recommended for difficult machining jobs and is supplied in four grades.

(*Communicated by the British Non-ferrous Metals Research Association*).

Powdered Metals in Machine Design—I. (*Machinery, December 31, 1942, Vol. 61, No. 1577, p. 737, 4 figs.*) ; (**II.** *January 7, 1943, Vol. 62, No. 1578, p. 1, 4 figs.*).

I. Powder metallurgy makes it possible to compress metal particles, so finely divided that they appear like flour or dust, into finished metal parts by the application of pressure and heat. The process does not involve any melting, casting, forging, rolling, extruding, or hammering of the metal ; and seldom is it necessary to do any machining work on the finished part. Bronze is the principal metal that has so far been used in making commercial metal-powder parts. However, iron powder is rapidly becoming important, because of the present scarcity of copper and tin. Advantages gained by the process. Some properties and applications of powdered metal parts. Parts made from iron powder. Specific advantages of powdered-iron parts. The pressures required for forming parts from metal powders may range from 10 to as much as 50 tons per square inch. Application of powdered metals to bearings. Powdered metallurgy used in making babbitted bearings.

II. Processing powdered-metal parts through the shop. When the parts have been formed, they are placed in a sintering furnace where the atmosphere is controlled to exclude oxygen. After sintering, the porous bearings are cold-sized and inspected. The sintering process. Procedure in making babbitted main and connecting rod bearings. Procedure in manufacturing powdered-metal gears. Properties of powdered-metal gears. The final inspection line, where the powdered-metal parts pass a rigid test. Limitations

of the powdered-metal process. An ingenious machine that continuously forces babbitt into the porous powdered-metal matrix of the bearing, after exhausting the air by vacuum.

MEASURING METHODS, APPARATUS.

Auto-collimator Test for Flatness, by W. A. Tuplin. (*Machinery, December 31, 1942, Vol. 61, No. 1577, p. 729, 8 figs.*).

Optical principle of auto-collimator and mirror. Measurement of difference in height by deviation of reflected ray from a tilted mirror. Departures from straightness. Corrected heights. Mounting the mirror for checking surface flatness. Procedure in checking flatness. The original datum line is first used for plotting the relative heights and then substituted by another which gives zero height to the end points. Numerical example. The setting points on a square network. Graphs applying the principle to determine the relative heights of the network points. Alternative network.

Quick Methods for Measuring Thickness, by E. S. Gallagher. (*The Machinist, January 30, 1943, Vol. 86, No. 42, p. 1155, 5 figs.*).

Parts manufactured from such metals as copper, brass, bronze, aluminium and aluminium alloy require new methods of measuring wall thickness with speed and accuracy. Gauges for such measurements have been developed in recent months and are now being used to solve many problems. The thickness of plating over steel parts can be measured by this gauge in a few seconds without destroying the plating on the part tested. Used in carburizing. The thickness of castings of non-magnetic metals, such as copper, brass, bronze, and aluminium alloy, can also be measured. Casehardened depth checked. Unbalanced reactances do it. A schematic diagram of the reactance bridge circuit used in various types of thickness gauges. Any coating on the steel surface has the same effect as an air gap on the lines of magnetic force and changes the reactance.

An Optical Oscillograph, by Kalman J. De Juhasz. (*Automobile Engineer, November, 1942, Vol. XXXII, No. 430, p. 483, 9 figs.*).

Early form of optical oscillograph for measuring the needle of an injection nozzle. Path of light beam of optical lever having two degrees of freedom of rotation. De Juhasz optical oscillograph. Rectifying light beams. Improved mirror assembly. Measuring injection pressure. Study of pressure cycle. Diagram of selector device of the observation of several events in succession. Optical oscillograph mounted on a rotary compressed air motor for indicating the pressure cycle. Latest type of optical oscillograph mounted on a fuel—injection test stand measuring needle valve motion.

METALLURGY OF STEEL.

"6-6" Moly Steels replaced by "4-6." (*Machine Shop Magazine, January, 1943, Vol. 4, No. 1, p. 37.*).

The manufacture of "6-6" quality high speed steel now ceases and all L.T licences already granted, or to be granted will in the future be executed in molybdenum "4-6" high speed steel. Analysis: Molybdenum 3.9-4.4 per cent; Tungsten 5.0-6.0 per cent; Chromium 4.0-5.0 per cent; Vanadium 1.40-1.60 per cent.

Molybdenum "4-6" should be handled in forging, annealing, machining, hardening or straightening in exactly the same manner as "6-6" quality

Rust-, Acid- and Heat-resisting Steels, by W. H. Hatfield. (*Inst. Chemistry Lecture, May, 1942, p. 48, B.N.F. Serial 25,483*).

In a preliminary discussion of the wartime position of special steels, author lists industries in which they are considered essential, non-essential or essential in certain cases. He gives a detailed survey of specifications, compositions and properties of these materials. Discussion. Notes on the fabrication of stainless steels are given in an appendix.

(*Communicated by the British Non-ferrous Metals Research Association*).

The Working of National Emergency Steels. (*The Machinist, January 23 1943, Vol. 86, No. 41, p. 1095*).

Limitations on elements : manganese, silicon, nickel and chromium, molybdenum, vanadium and tungsten, special addition agents. The selection of a steel. Forging and heat treatment. Actual applications of NE steels. Machining NE steels : (1) speeds and feeds for national emergency steels, (2) milling, (3) broaching, (4) drilling, (5) tapping and threading, (6) suggested wheels for grinding NE steels, (7) sawing, (8) cutting oils for NE steels.

SMALL TOOLS.

Milling Cutting Power Requirements, by O. W. Winter. (*The Tool Engineer, November, 1942, Vol. XI, No. 11, p. 78*).

Unknown factor : feed permissible.
Known factors : (1) Material being milled ; (2) Type of cutter to be used ; (3) power rating of milling machine ; (4) width and depth of cut ; (5) R.P.M. of cutter ; (6) number of teeth in cutter ; (7) products of No. 5 and No. 6 ; (8) efficiency of the milling machine. (1) Two cutters, (2) three or more cutters. Unknown factor : power required.

The Design and Construction of Die Casting Dies, by H. K. Barton. (*Machinery, Die Casting Supplement, December 31, 1942, Vol. 61, No. 1577, p. 750, 7 figs.*).

Factors which are common to all die casting dies, the elemental methods of construction. Length of run. Die blocks. Core blocks. Metal pressure. Holding cores.

Ejectors for Die Casting Dies, by H. K. Barton. (*Machinery, January 28, 1943, Vol. 62, No. 1581, p. 106, 5 figs.*).

Examples of pin ejection. Recommended methods versus common faults. Shrinkage of the metal when cooling may cause excessive strain on parts of the casting. Means of equalizing pressure. Methods which use sleeves for the purpose of ejection. Typical example of stripper plate ejection. A simple example of the use of compressed air for the ejection of castings. Table of recommended standards for ejectors.

Hardness Differences in Diamonds, by Paul Grodzinski. (*Industrial Diamond Review, February, 1943, Vol. 3, No. 27, p. 7, 4 figs.*).

Distinction should be made between : (a) The hardness of the diamond in relation to other materials ; (b) the hardness differences between diamonds from the various localities ; (c) hardness differences in the surface or crystal surface or layers of a single diamond. Comparison of hardness values. General data according to wear tests of F. Karpinski. Results of wear calculation. Comparative wear results. Individual hardness differences.

STANDARDISATION.

Draft in Inches for Die Clearance Angles, I and II, by W. J. Woodworth and P. T. Woodworth. (*The Machinist, January 30, 1943, Vol. 86, No. 42, p. 1190 and 1991*).

SURFACE TREATMENT.

The Formation and Evaluation of Zinc Coatings, Parts VII and VIII. (*Sheet Metal Industries, January, February, 1943, Vol. 17, Nos. 189 and 190. p. 69 and 243, 3 figs.*).

Part VII. Corrosion. Zinc v. cadmium coatings. Relative rates of corrosion of iron, zinc and cadmium. Corrosion resistance of different types of zinc coating. Zinc-cadmium alloy plates. Contribution by the tests of the American Society for Testing Materials.

Part VIII. Methods of testing. Apparatus and conditions of operation. Uniformity of the coating. The jet test. The dropping test. A suitable apparatus for the dropping test. Wernlund's method. Determination of the average thickness. Hydrochloric acid. Sulphuric acid. Basic lead acetate. Ammonium persulphate method. Britton's test. Cushman's method. The chord method. Magnetic tests. The determination of porosity. The determination of adhesion. Other tests.

Infra-red Radiation. (*Aircraft Production, February, 1943, Vol. 5, No. 52, p. 83, 9 figs.*).

The employment of infra-red rays for certain operations, notably paint-drying and shrink-fitting. Surface absorption. Paint drying. Other applications. Parabolic reflectors. Trough reflectors. Infra-red plant for drying the enamel coat of franklin aero engines. The work is conveyed by overhead mono-rail and suspended in the tunnel for 10 minutes. Section of a circular radiant tunnel, showing the use of parabolic reflectors. Trough equipment. Automatic switching.

Application of Flame Cutting and Automatic Welding in Shipbuilding, by R. E. Doré and R. R. Sillifant. (*Trans. of Inst. of Engineers and Shipbuilders, January, 1943, Vol. 86, Part 3, p. 55, 14 figs.*).

Flame cutting. The precision and quality of the cut surface is affected by a number of variable factors, the most important of which are as follows : (1) Absence of lateral movement of the cutter. (2) Uniformity of longitudinal movement of the cutter. (3) Correct cutting speed. (4) Correct size of cutting nozzle. (5) Cleanliness of cutting nozzle orifice. (6) Uniformity of oxygen pressure regulation. (7) Degree of preheating flame. (8) Condition and uniformity of steel being cut. Cutting conditions. Conditions and uniformity of steel plates. Effect of oxygen cutting on steel. Flame cutting developments for plate edge preparation. Effect of cutting laminated steel plate. Typical straight-line power driven gas cutting machine with swivel head for bevel cutting. Types of plate edge preparation for welding. Arrangement of cutting nozzles and sequence of cutting for plate edge preparation. Flame cutting machine with floating assembly for cutting blowpipes. Development of flame cutting machines in America. The " flame-planer " machine for preparing simultaneously the four edges of a plate. Special template-following machine for bevelled edge cutting. Future development of flame cutting in Great Britain. Automatic Arc Welding. Description of the unionmelt process. " U " type welding head. Complete welding equipment.

Wiring diagram showing earth protection on unionmelt power pack. Typical applications of automatic welding. (a) Square butt. (b) Square butt, part bevel. (c) Butt in heavy plate, bevel both sides. (d) Square butt over supporting member. (e) Non-positioned fillets. (f) Plug welds. Properties of unionmelt welds.

The Use of Spot Welding in Design and Production of Aircraft, by G. S. Mikhalapov. (*Welding, January, 1943, Vol. XI, No. 2, p. 47, 4 figs.*).

The equipment available on the market for spot welding of aluminium exceeds in refinement and quality any that has ever been offered or is being offered for welding of ferrous alloys. Control of weld quality. Quantities produced. Structural requirements. Weld failures. Fatigue value of spot welds. Present use of spot welding in aircraft. Selection of parts best suited for spot welding. Types of stiffener panel combinations. Examples of poor design for spot welding. Examples of good production design. Poor production and spot welding design. Excessive number of parts. Excellent production and spot welding design. Less parts to make. Recommended minimum weld spacing, edge distance, clearance. Process control and requirements. Spot welding schedule.

A New Hammered Resistance Welding Process, by A. L. Pfeil. (*Welding, January, 1943, Vol. XI, No. 2, p. 66, 4 figs.*).

The paper describes welding by a combination of electric heat and hammering. It is stated that the process produces a good weld without flash or fin and with low power consumption

British and American Welding Specifications, by J. Corston Mackain. (*Welding, January, 1943, Vol. XI, No. 2, p. 57*).

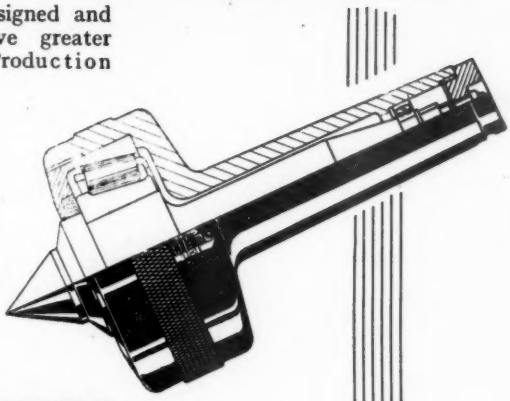
"IT'S THE CENTRE THAT CARRIES THE LOAD"

ere are two centres designed and oved by tests to give greater ficiency on modern Production achines.

VORTEX
ROLLER BEARING

constructed to stand up to e higher speeds and heavier tting loads which modern tting tools and machines emand. Its special features e:

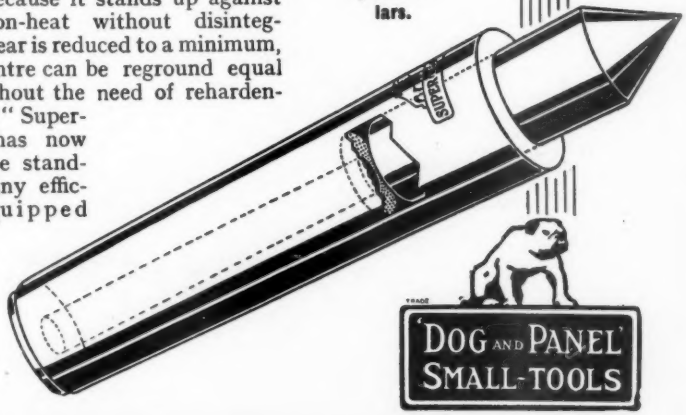
1) Short overhang.
2) Fully protected bearings.
3) Centre spindle with bearings both ends.



The SUPER-CENTRE
Fitted with High-Speed Steel Insert

HIGH SPEED steel is ideal for Lathe entres because it stands up against he friction-heat without disintegating. Wear is reduced to a minimum, nd the centre can be reground equal o new without the need of reharden-ng. The "Super-entre" has now ecome the standrd in many efficently equipped orks.

Write to-day for full particulars.



'DOG AND PANEL' SMALL-TOOLS

WEARDEN & GUYLEE LTD
LOUDEN TOOL WORKS, ARCHER ROAD, SHEFFIELD 8

All communications regarding advertisements should be addressed to the Advertising Manager, T. G. Scott & Son, Ltd., Talbot House, 9, Arundel St., London, W.C.2. Phone: Temple Bar 1942.
Printed by Richard Bates Limited, 9-13, Stockton Street, All Saints, Manchester 15.